

# Mount Diablo Astronomical Society

## *Diablo Moon Watch*

November 2011

### **GENERAL MEETING**

**Tuesday November 15, 2011**

## **Interferometric Measurements of the Size and Behavior of Stars**

*(Including size changes)*

*By Dr. Charles Townes*

*Doors open at 6:45 p.m.*

*Concord Police Association Facility  
5060 Avila Road, Concord*



***Charles Hard Townes is an American Nobel Prize-winning physicist and educator.***

Townes is known for his work on the theory and application of the maser, for which he received the fundamental patent, and other work in quantum electronics connected with both maser and laser devices. He shared the Nobel Prize in Physics in 1964 with Nikolay Basov and Alexander Prokhorov. The Japanese FM Towns computer and game console is named in his honour.

A member of the technical staff of Bell Telephone Laboratories from 1933 to 1947, Townes worked extensively in designing radar bombing systems and has a number of patents in related technology. From this he

turned his attention to applying the microwave technique of wartime radar research to spectroscopy, which he foresaw as providing a powerful new tool for the study of the structure of atoms and molecules and as a potential new basis for controlling electromagnetic waves.

At Columbia University, he continued research in microwave physics, particularly studying the interactions between microwaves and molecules, and using microwave spectra for the study of the structure of molecules, atoms, and nuclei. In 1951, Townes conceived the idea of the maser, and a few months later he and his associates began working on a device using ammonia gas as the active medium. Townes and his students coined the word "maser" for this device, which is an acronym for microwave amplification by stimulated emission of radiation. Other research has been in the fields of nonlinear optics, radio astronomy, and infrared astronomy. He and his assistants detected the first complex molecules in the interstellar medium and first measured the

mass of the black hole in the center of our galaxy.

In addition to the Nobel Prize, Townes has received the Templeton Prize, for contributions to the understanding of religion, and a number of other prizes as well as 27 honorary degrees from various universities.

### **WHAT'S UP**

***Richard Ozer will present highlights from this year's Golden State Star Party as well as some of the history leading up to it's current location in Modoc County.***

# PRESIDENT'S CORNER

## The Advanced Imaging Conference (AIC)

by Chris Ford

*The Advanced Imaging Conference is the worlds leading event for the astrophotography community and the often extraordinary equipment associated with this aspect of amateur astronomy.*

results. If you have a question, you just ask an expert.

*AIC is also an opportunity to goggle at some of the most interesting and often expensive telescopic and camera equipment available to the public.*

For some the sky is literally the limit, though AIC equally caters to more digestibly priced equipment. This is where Celestron and Orion rub shoulders with RC Optics and Apogee. It is though always interesting to see how much some astrophotographers are

tories. The vendors hall showcased 36 exhibitors, most of



whom offered special AIC discounts, and if you are contemplating a \$36,000 telescope that is not to be dismissed. Such was the accumulation of astronomical equipment displayed in Santa

Clara, that it will probably rain non-stop for the next 6-months.

However what AIC is really about is celebrating the art of astrophotography and the techniques that lie behind

it. How so many amazing images are now created by amateurs that rival and often exceed images taken by professional observato-

This years 8th meeting held at the Hyatt hotel in Santa Clara between Nov 4th to Nov 6th 2011, and attended by over 300 attendees from all over the world was the largest yet. This was my 4th AIC, and for this months Presidents Corner I have assembled an overview and photo-tour to give you a flavor of the proceedings.

AIC is a veritable "who's who" of astro-photography with a very high proportion of amateur astrophotographers in attendance whose work appears in the back pages of Sky & Telescope and Astronomy magazine. As such, it is an excellent opportunity to meet some of the most accomplished practitioners of this technical art. It is also a very friendly and sharing event with advice given freely on how to achieve specific



prepared to spend in their pursuit of that last elusive photon, not just telescopes and cameras, but land purchases in remote national forests and entire remote observa-



### The Advanced Imaging Conference (AIC) *(Continued from the previous page)*

ries just a couple of decades ago, and can even compare with early Hubble images. Astrophotography at this level is a great technical art and AIC is all about workshops with titles such as “The ABC's of image processing”, or “Taking the

this years Hubble Award winner and Godfather of CCD astrophotography, Ron Wodaski. AIC is also usually attended by telescope makers and opticians of the highest renown such as Roland Christen of Astro-Physics, Paul

Jones of Star Instruments, and Peter Ceravolo, all of whom are approachable and accessible. It is this accumulation of talent and expertise all under one roof

that gives AIC it's special flavor. Oh, and Alex Filipenko dropped in to present this year also.

***For a full 3-day (and evening) event, AIC is not unreasonable value.***

\$399 buys admission, full breakfast, lunch, and dinner fully provided for 3-days, and some amazing takeaways, including this

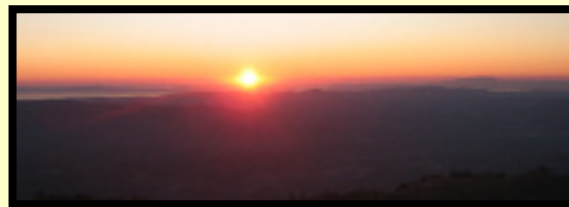
year a free copy of Ron Wodawski's Zone System for Astro Imaging, free photoshop tutorials on vendor booths, and of course those AIC discounts. The prize raffle on Sunday included outstanding prizes, many worth thousands of dollars such as observing and imaging time on major telescopes, narrow-band filters, books, training DVD's, guiding packages, and even complete camera's. Given that there is a 1 in 300 chance of winning the odds are not unreasonable. This is an event that no one leaves empty handed. The prize I particularly wanted to win was a \$4,000 value Apogee CCD camera. The winning ticket was #914... I was holding ticket number #913. Hopefully better luck next year!

<http://www.aicccd.com/>



mystery out of flat fielding” or how about “The hydrogen sky, having fun with 6 billion pixels of light exposure” or for the very dedicated “Interpreting interferograms and collimating Ritchey-Chretien optics”. These and other topics were delivered at AIC by well known names such as Adam Block, R J Gabany, Tony Hallas, Don “Astrodon” Goldman, Dennis “Sky & Telescope” Di Cicco, and

## October Public Star Party on Mount Diablo



## Basic Discussion of Quantum Physics

by Nathaniel Bates

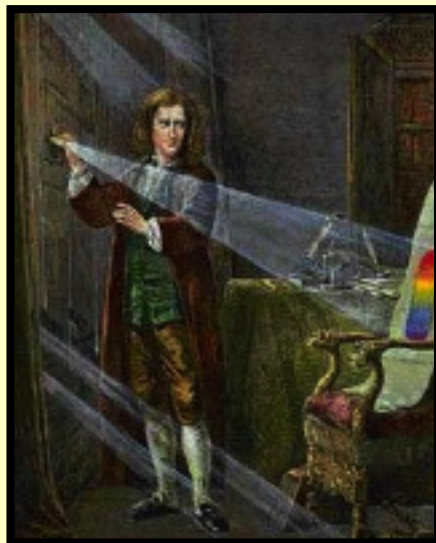
*Dedicated to Vic Bates, 1935-2011*

***Our last guest, Professor Lloyd Knox, discussed the notion that galaxies may have begun as quantum fluctuations in the early Universe.***

Piggy-backing on his talk, I figured that I would discuss just what Quantum Physics is, given that it is so crucial to modern cosmology and modern astronomy. Let me preface by stating that I am not an expert in the subject. I do not feel worthy of addressing a concept that is so lofty and largely beyond my ability to make sense of it. Let me also preface by stating that there is a great deal of pseudo-science that attempts to wrap itself in the “quantum” mantle. However, Quantum Physics is itself a legitimate science that has many strange and quirky aspects to it that might seem somewhat paranormal. In some sense, the quantum level is where the rational and the marvelous meet, where the seemingly miraculous meets the miracles of science.

***Quantum Physics is a study of the very small.***

It is the study of subatomic particles and how they interact. One of the most important discoveries of Quantum Physics has been to show us that on a basic level the idea of a subatomic particle as being a ball like object moving through space is fundamentally flawed. The atomic nucleus has been imagined to be protons and neutrons bonded



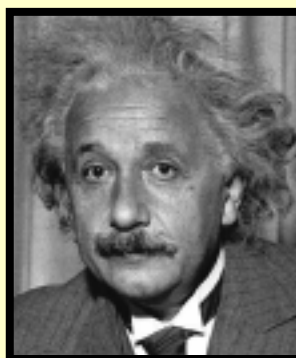
together, with electrons orbiting around them like planets. However, this “Solar System” model is really a model that is a best fit to the human mind. It is the best way of describing a reality that is actually more complex, and more wonderful. In actuality, subatomic particles are not solid at all. They are particles but also waves. Some have envisioned them as being waves on a vast cosmic ocean. These waves interact with other waves and form wave interference patterns that eventually build up what appears to be solid matter but which is actually the interactions of astronomically high numbers of waves.

***How can something be both a particle and a wave?***

Prior to Einstein, scientists had gone back and forth on the ques-

tion of whether light was a particle or a wave. Newton suggested that light had a particle nature.

However, scientists in Europe suggested that light was a wave. Einstein gave very solid evidence suggesting that light was particle in nature. However, at the very same time, other experiments were confirming that light was of a wave nature. Quantum Physics was born of the determination that light was both a particle and a wave. Light was “particle” for purposes of understanding position, but “wave” for purposes of understanding momentum. In essence, “particle” and “wave” were different aspects of our understanding of light. The question of whether a photon was a



particle or a wave depended on how one measured it. A measure of subjectivity entered in to science that had never been considered before. It was almost as if how one measured the photon determined what a photon was at that

moment.

***Why was the way that one measured a photon so important?***

One could not know the exact position and the exact momentum of a photon at the same time. The very measurement that one employed interfered with what was being measured. Remember that Einstein had established the speed of light as



## Basic Discussion of Quantum Physics *(Continued from the previous page)*

the absolute speed that anything could travel. His cosmic speed limit also meant that precise



measurements ended when what was being measured was too small. If Relativity limited speeds to the speed of light, it also limited what could be known about the exact location of a particle and its exact momentum. The Heisenberg Uncertainty Principle, discovered by physicist Werner Heisenberg, established the fact that we cannot know the exact momentum and the exact position of a subatomic particle at the same time, and it did so in precise mathematical terms! Yet, the philosophical implications of Quantum Physics went even further. Some scientists even began to question whether or not our familiar notions of reality could answer the question of what the Universe is on a small enough scale!

***Quantum Physics began to show that light and other forms of energy could be broken down into discrete “quanta.”***

In other words, if an atom were to absorb enough light energy to cause an electron to climb the electron shells of an atom,

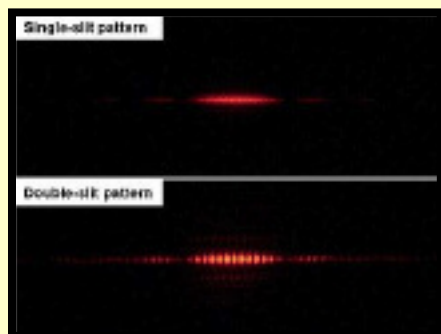
that energy would be absorbed in packets known as light “quanta.” The electrons would not simply absorb energy and then jump. They would only be able to jump when they absorbed the exact amount of energy necessary to make the jump. It is as if a pot of water was boiling, but could only start boiling once exactly enough energy was applied, never even seeming to heat up before that point. The pot did not warm up when you turned on the stove. Only when you gave it enough energy did it suddenly start boiling, immediately and at that exact time. In Nature we observe energy increasing smoothly. Birds take off smoothly with the wind. We run smoothly as our legs bring us to a fast pace. Indeed, planes glide smoothly as we fly them as so much of Nature evokes smoothness in us as we observe her ways. However, on the subatomic level we do not find smoothness. Energy is absorbed in packets. Between these discrete values we cannot actually make measured determinations about energy states. In some sense, you might even say that energy states in between these quanta do not exist. The Universe mysteriously makes leaps. We might suggest that when an electron jumps energy levels there is no “in between” energy levels. The electron goes from one shell to another without necessarily passing through an in-between step, a fact that suggests that the subatomic realm is more of a mysterious Wonderland than something that we can impose our everyday ideas of reality upon.

***One more mysterious fact needs to be considered.***

On the quantum level, we have a phenomenon that seemingly contradicts Relativity’s position that light is the cosmic speed limit. Now, I want to preface what I am about to say by noting that light is the speed limit for matter/energy. It is not necessarily the speed limit for information provided that causality is not violated (this issue is debated). I am not going to go fully in to the EPR experiment, but I encourage my reader to research it because it makes for fascinating if difficult reading. Let us instead discuss the double slit experiment, a simpler experiment to understand but every bit as mysterious. The double slit experiment is easy to understand on the surface of things. If a light beam shines through two narrow slits, an interference pattern is cast on a distant wall. That interference pattern is akin to water waves that pass through two rocks, a kind of overlapping pattern. Now, if I simply pass two photons through the two slits, then they should simply be cast on the walls and should not form that wave pattern. In other words, if I were simply to pass two balls through two holes in the wall, they would simply pass through and not form any kind of wave pattern. However, light is a wave as well as a particle. When there are two slits, there is a wave pattern even though the photons passing through one slit do not directly interfere with the photons traveling through the second slit. The

## Basic Discussion of Quantum Physics *(Continued from the previous page)*

fact that we measure light traveling through two slits means that the photons scatter in a wave pattern. No direct contact between the photons traveling through one slit or the other is necessary to form the wave pattern.



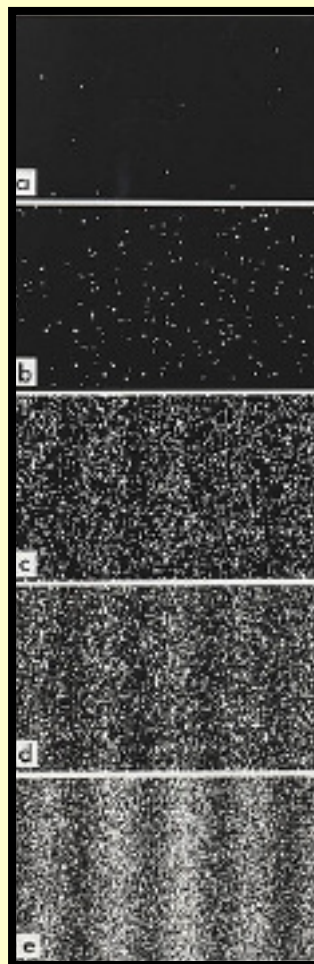
### *Why is this so mysterious?*

If we have simply one photon and one slit, then we do not have a wave pattern cast on the distant wall. However, the mere existence of the second slit means that the wave pattern is formed. It is as if we had balls shot through a hole in the wall, but then a second hole in the wall emerged that caused our balls to have some mysterious information exchange with one another that meant that they would curve in to different directions forming a complex pattern on the far end of the wall after enough balls went through the two holes. Does information actually pass between photons? Do they tell one another to form mysterious wave patterns once observed by human instruments? Such notions are often dismissed as pseudo-science by physicists who will point out that photons are not actually balls traveling through space. Also, scientists do not tend to like subjectivity. Most believe in an objective Universe

that is independent of human measurement. At the same time, these issues are debated with scientists still seeking to unify Relativity's cosmic speed limit with the seemingly instantaneous communication that Quantum Physics suggests is possible. More to the point, many are attempting to unify the objectivity that science demands with a Universe that seems to give us a reality that conforms to what we measure on the Quantum level.

### *Double slit experiment done with electrons, showing that electrons have a "wave nature" as well as a particle nature.*

When our guest suggested that galaxies may have begun as quantum fluctuations in the early Universe, he was making a radical statement. He was suggesting that our familiar astronomical categories of objects, objects such as galaxies and clusters of galaxies that exist on the macro-scale, are made possible by fluctuations on the Quantum scale. I neglected to mention that Quantum Mechanics allows space itself to possess an energy state, a mysterious fact in and of itself. However, it is even more mysterious when we remember that a



given energy state will fluctuate on a very small scale, a fact made necessary by Heisenberg's Uncertainty Principle. So, it is possible that galaxies began as small fluctuations in space itself. If this is proven to be true, perhaps by the discovery of the Higgs particle, or some other confirmation, it would be a bridge between the mysterious Quantum world and the everyday world. The world of Classical and Relativistic Physics on the cosmic scale would then be linked to the mysterious non-locality of the very

small scale. A whole mysterious new Universe would open on top of an already mysterious Universe. Are we ready? I am!

*Special thanks to J.Z. for his assistance.*



## Mount Diablo Astronomical Society Event Calendar–November 2011

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	Bay Area Science Festival 1	Bay Area Science Festival 2 3rd Grade Starwatch (Private)	Bay Area Science Festival 3	Bay Area Science Festival 4	3 events: Click here to view 5  Sunset: 6:07 PM
Bay Area Science Festival 6	Board Meeting (Private) 7	MDAS Imaging SIG (Private) 8	9	10	Veterans Day 11	12  Sunset: 5:00 PM
13	14	7:15 PM GenMtg: How Stars Change 15	MDCA Board Meeting (Private) 16	LADEE Mission Telecon (Private) 17	18	Society Observing (Private) 19  Sunset: 4:55 PM
20	21	22	23	Thanksgiving Day 24	25	Society Observing (Private) 26  Sunset: 4:52 PM
27	28	29	Twin Creeks Elementary (Private) 30	1	2	3

## Don't Miss "The Fabric of The Cosmos" on PBS

*A NOVA Four Part series with best selling author Brian Greene.*

### *What is Space?*

Aired Wednesday November, 2

### *The Illusion of Time*

Aired Wednesday November, 9

### *Quantum Leap*

Airing Wednesday November, 16

### *Universe or Multiverse?*

Airing Wednesday November, 23

This superb 4 part NOVA series will be most likely repeated on different PBS channels 10, 17, 22 etc.





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MDAS

P.O. Box 4889

Walnut Creek, CA 94596-

#### *General Meetings:*

Fourth Tuesday every month,

except on the third Tuesday

Refreshments and conversations

Meetings begin at 7:15pm.

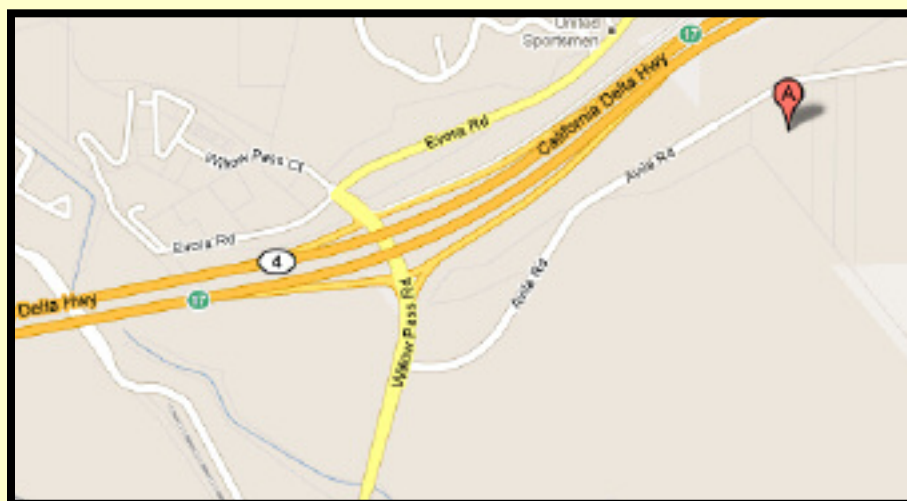
#### *Where:*

Concord Police Association

5060 Avila Road, top of the

Take Avila Road from Willow

#### *Directions to facility:*



## Your Help Would Be Greatly Appreciated

Our association needs a few members to come at 6:30 p.m. before our monthly meeting which starts at 7:15 p.m. to help in setting up the chairs and other elements needed to conduct the general meeting.

Similarly at the end of each meeting the chairs and tables have to be removed, the room has to be cleaned and the garbage emptied.

*Thank you for your help.*

